1.5 Upward, seasonal adjustments to the base catch limit

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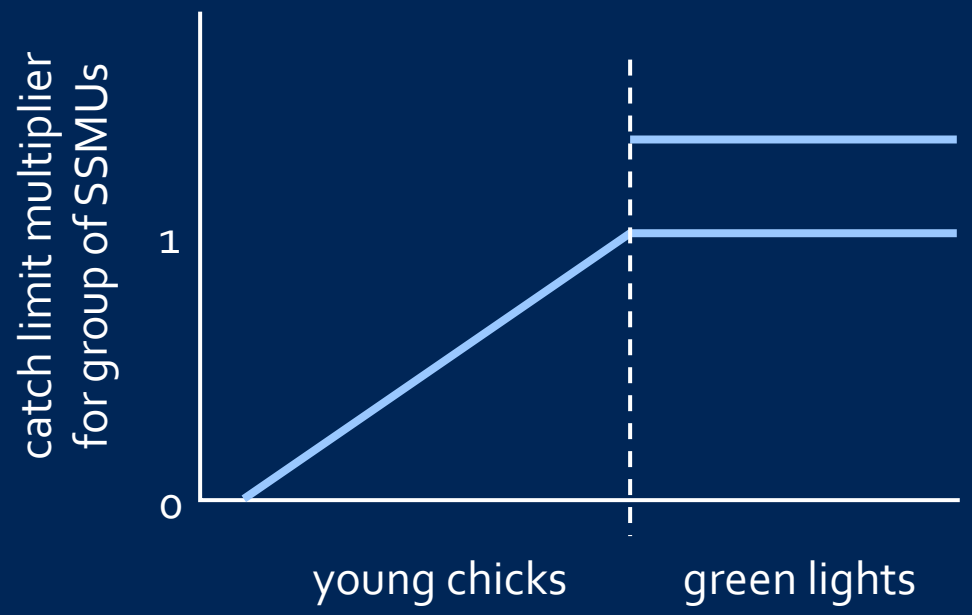
Southwest Fisheries Science Center
Antarctic Ecosystem Research Division

TOR QUESTIONS: 5, 6

Under what environmental/ biological conditions might krill harvest be increased above the base catch limit



1.6 Synthesis

1.5 Adjust up

1.4 Base catch limit

1.6 Adjust down

1.2 & 1.3 Background

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How can we use krill and predator data to provide a framework for increasing local catch limits during “good” conditions?

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Data necessary for assessing conditions to adjust local catch limits upwards

- Fishery monitoring of krill trends during season
  - Use U.S. AMLR acoustic data as a proxy for fishery data (to examine efficacy of repeat transects)
- Use of CEMP to develop stoplight to assess status of predator populations
  - Use U.S. AMLR predator indices that are part of CEMP to develop ideas

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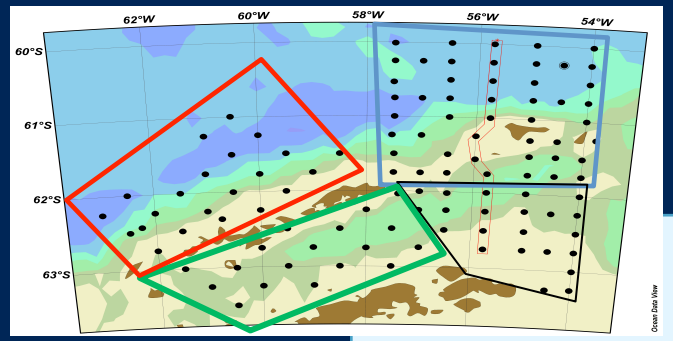
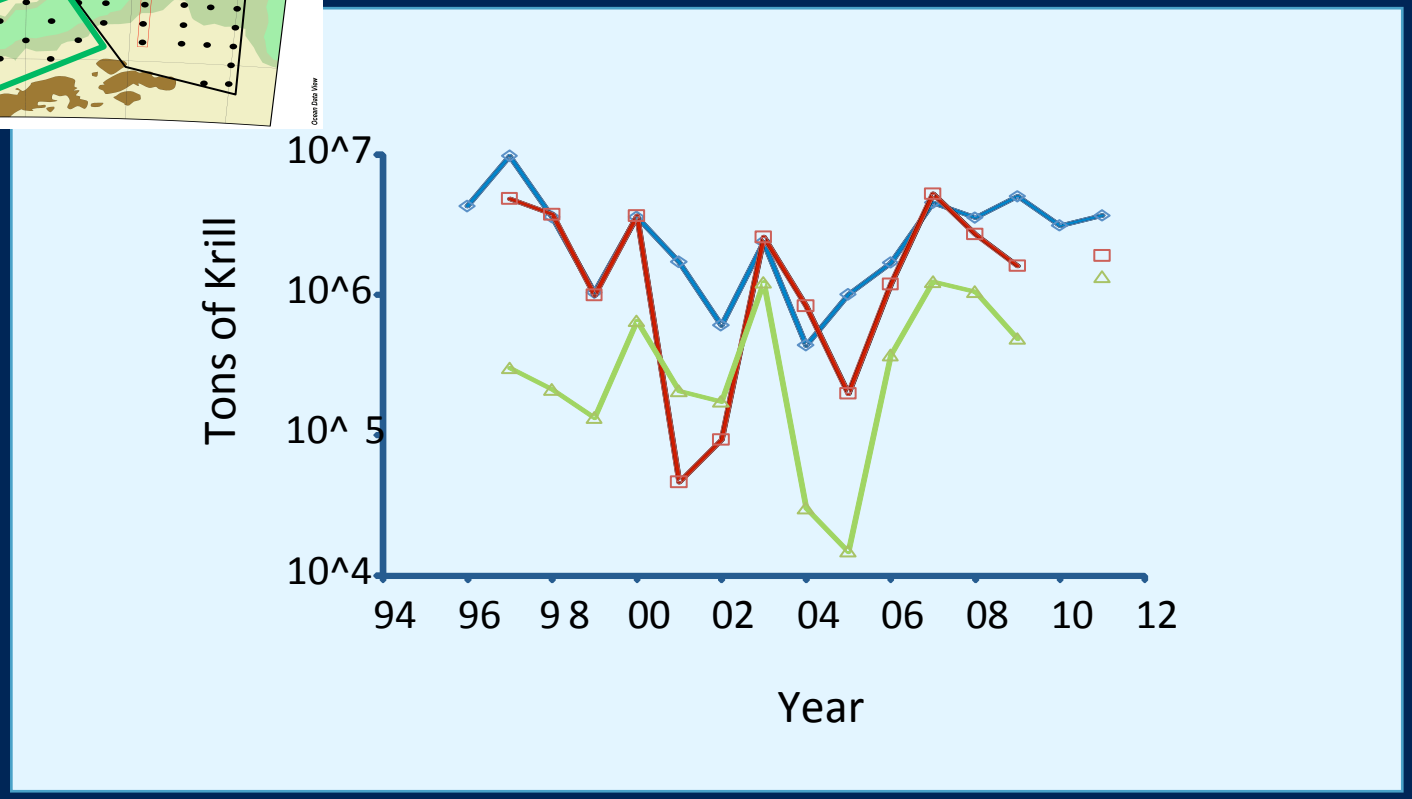
High inter-annual variability in biomass suggests that fixed catch limits may be too conservative in some years





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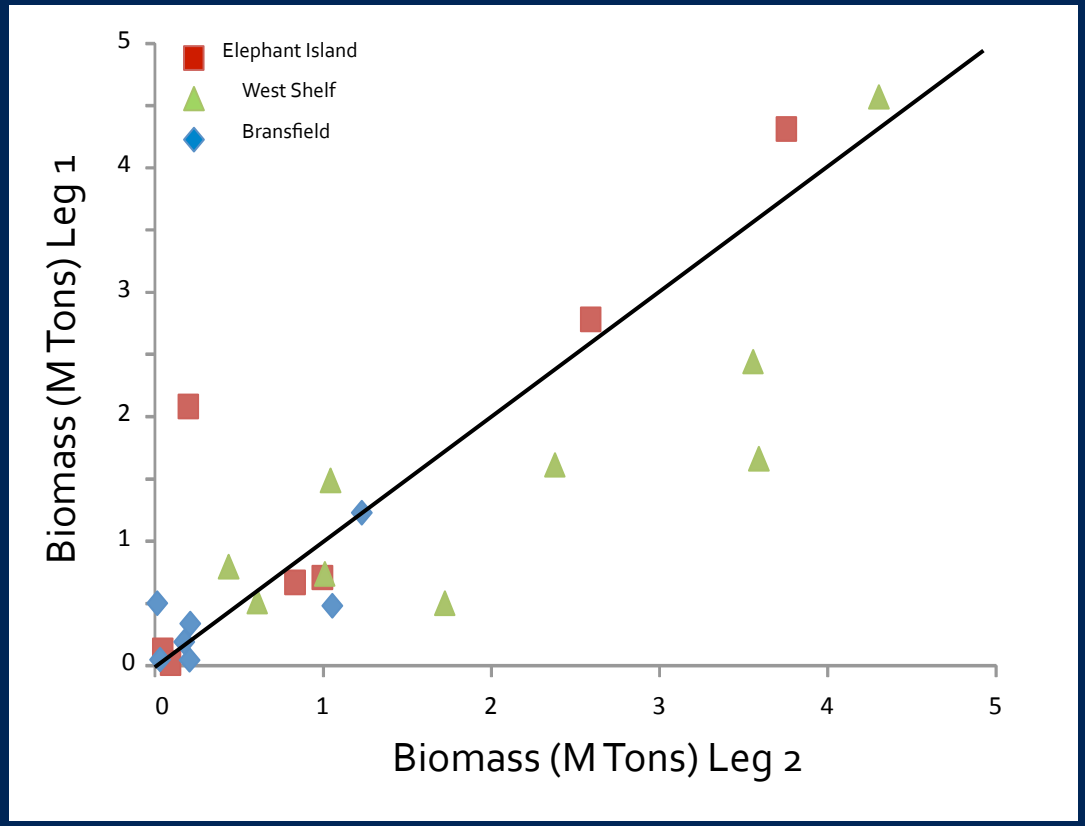
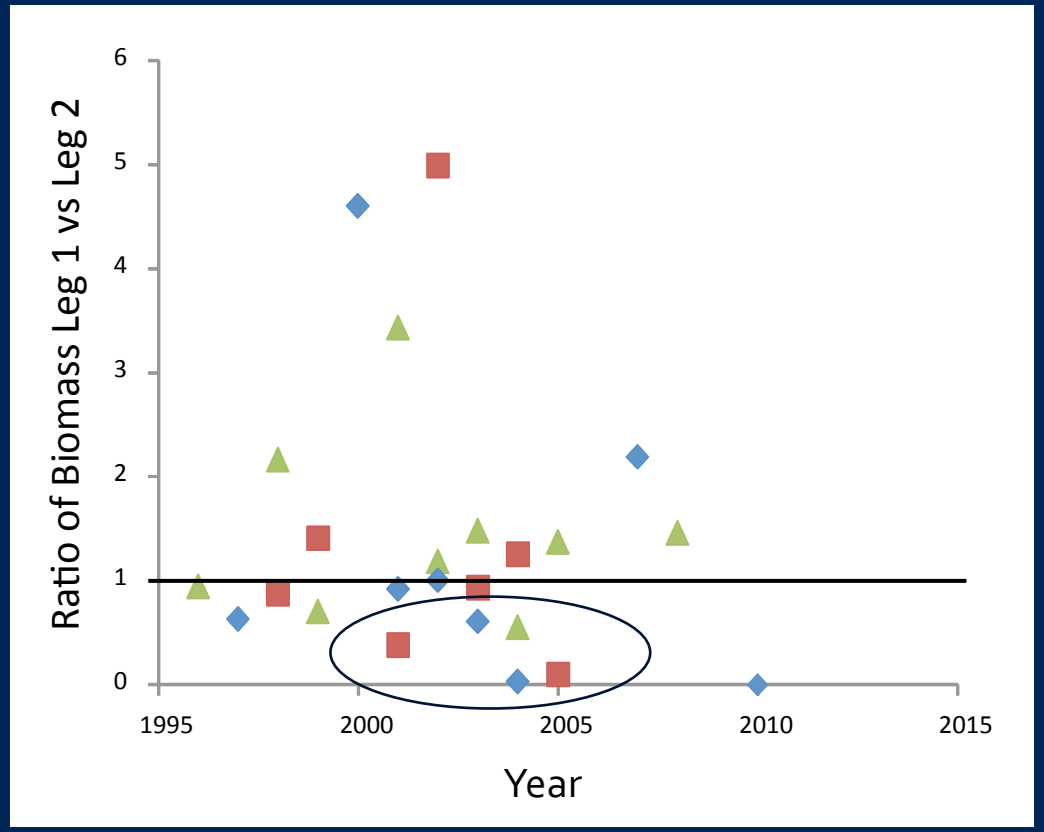
The correlation of biomass between survey legs and ratio of biomass between legs shows periods of increased biomass during summer





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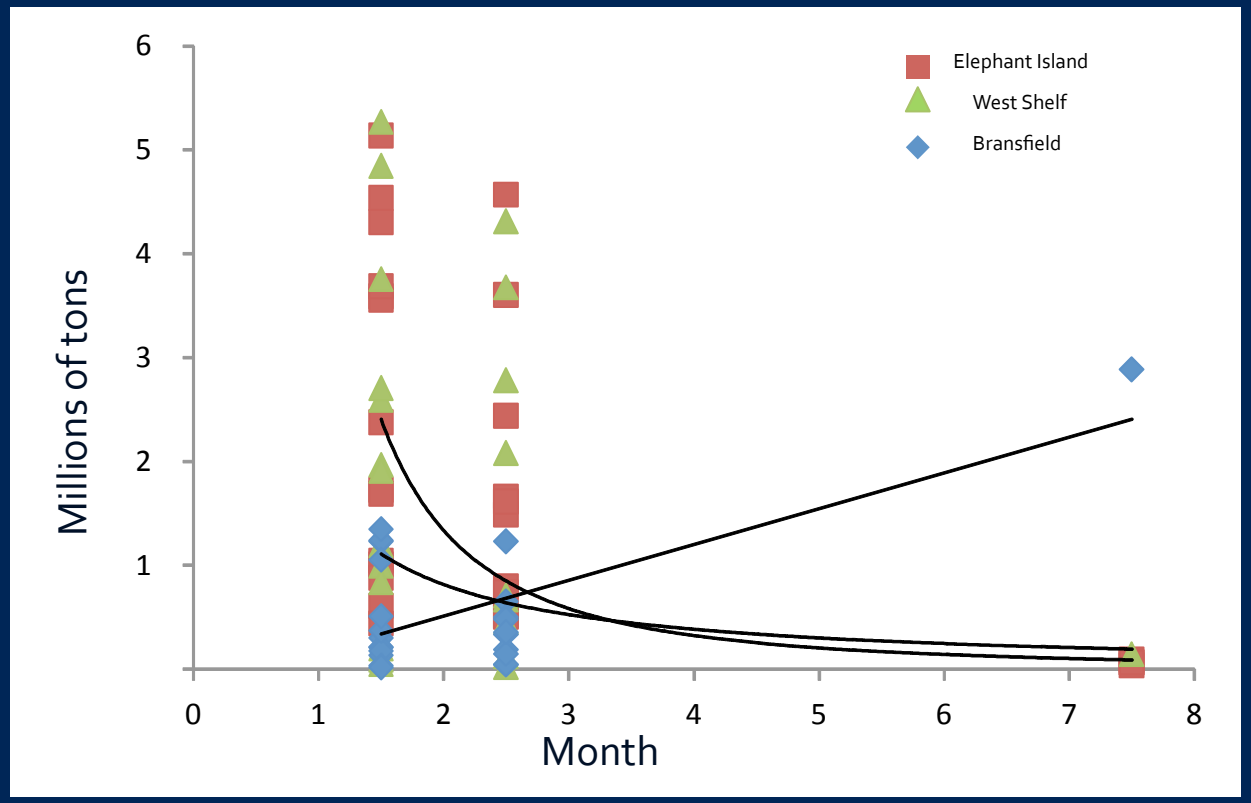
Seasonal changes in biomass show that fishing might continue in where biomass increases



Seasonal changes in krill biomass also suggest changing distributions

Shift of fishing effort from offshore to inshore areas with seasonal changes

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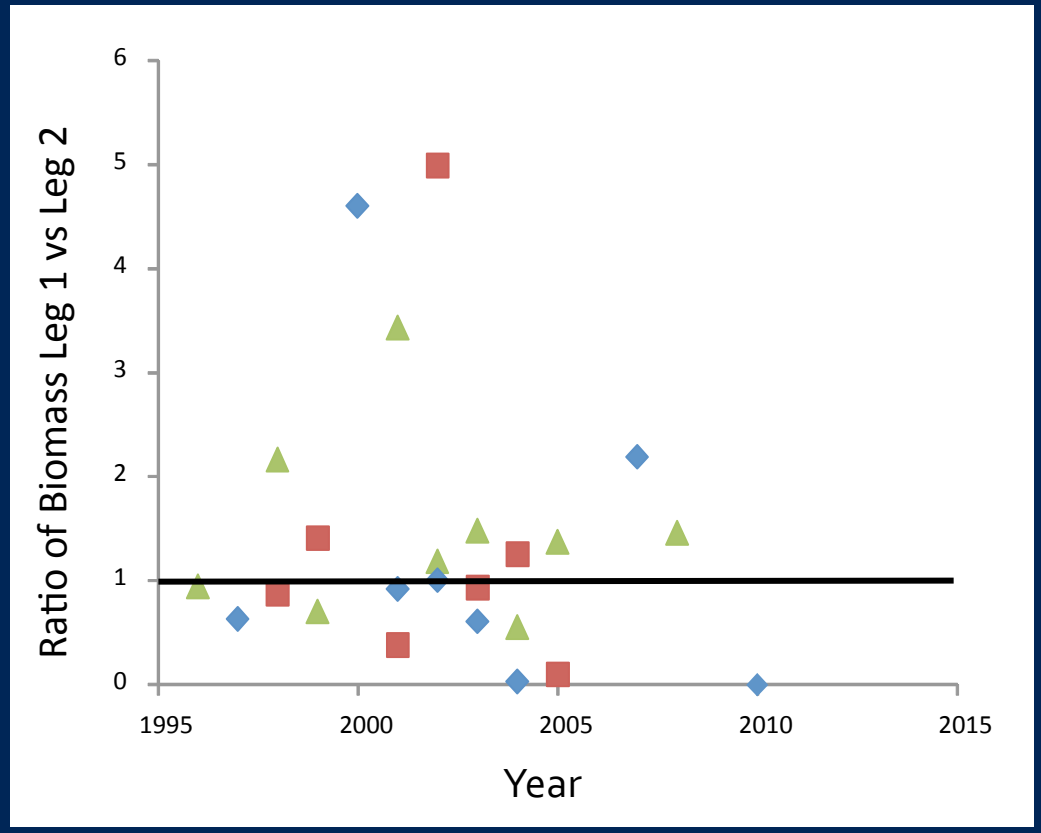
Ratio based appraisal of krill decline over the season



Years where krill biomass was significantly lower between legs

Years where krill biomass is stable or higher between legs

Krill years can be classified as increasing, decreasing or neutral and be used as an index for modifying catch

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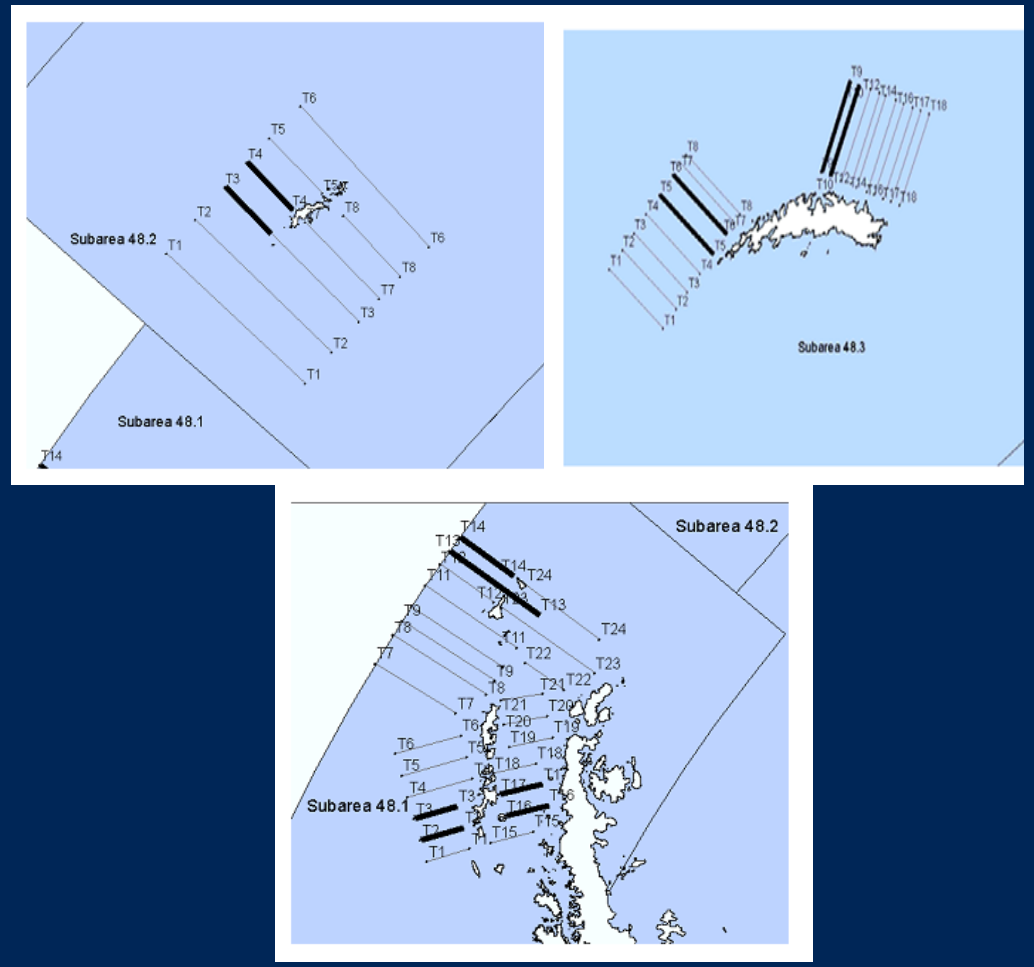
How can we use fishing vessels to monitor krill trends in fishing areas

- CCAMLR has prescribed repeat transects in fishing areas
- Voluntary participation to repeat these transects by fishing vessels



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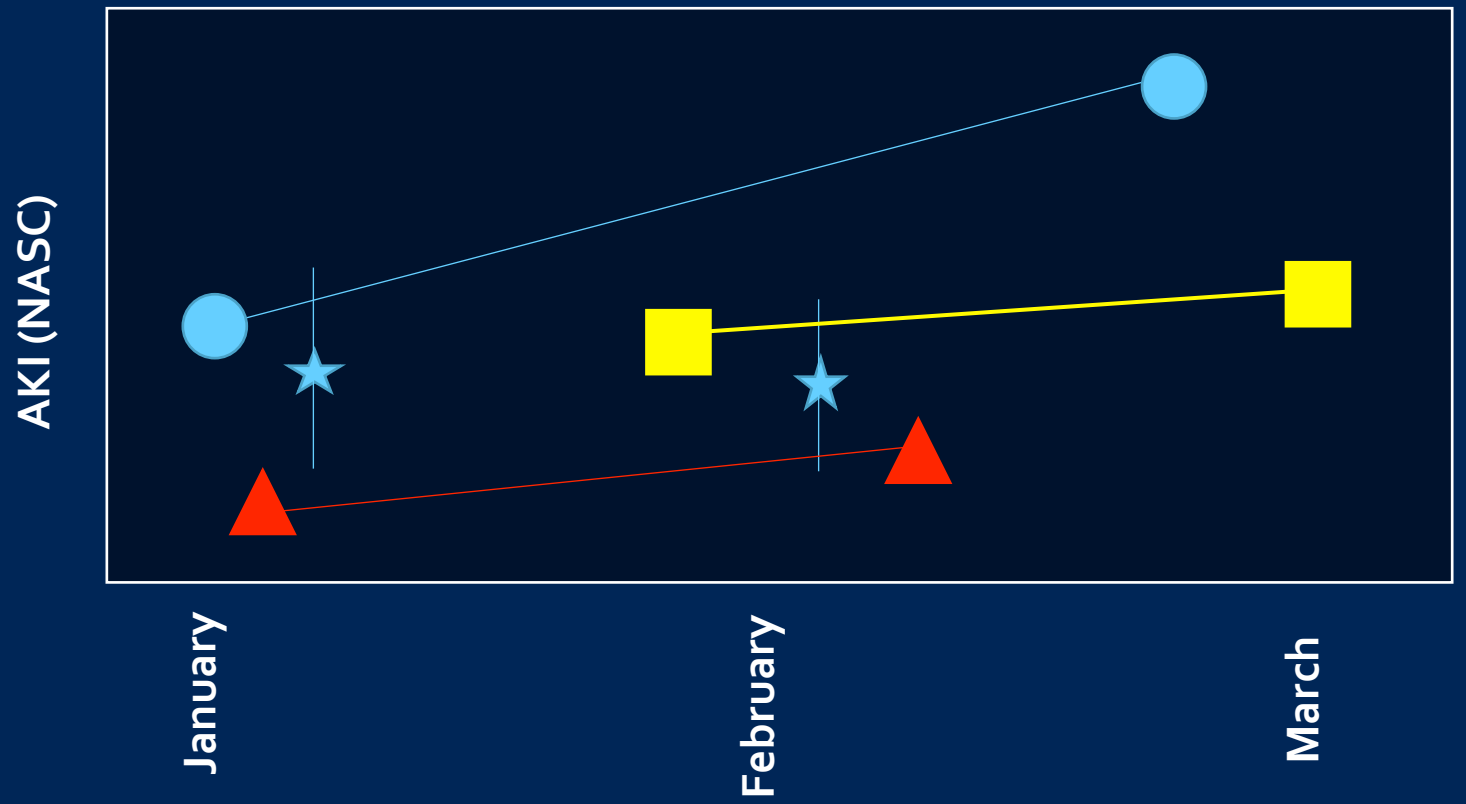
Acoustic Krill index (AKI) trends from repeat transects

RV / FV Calibrated biomass survey

FV1 Calibrated AKI

FV2 Un-calibrated AKI

FV3 Un-calibrated AKI



Can fishing vessels indicate within-season trends in krill biomass?

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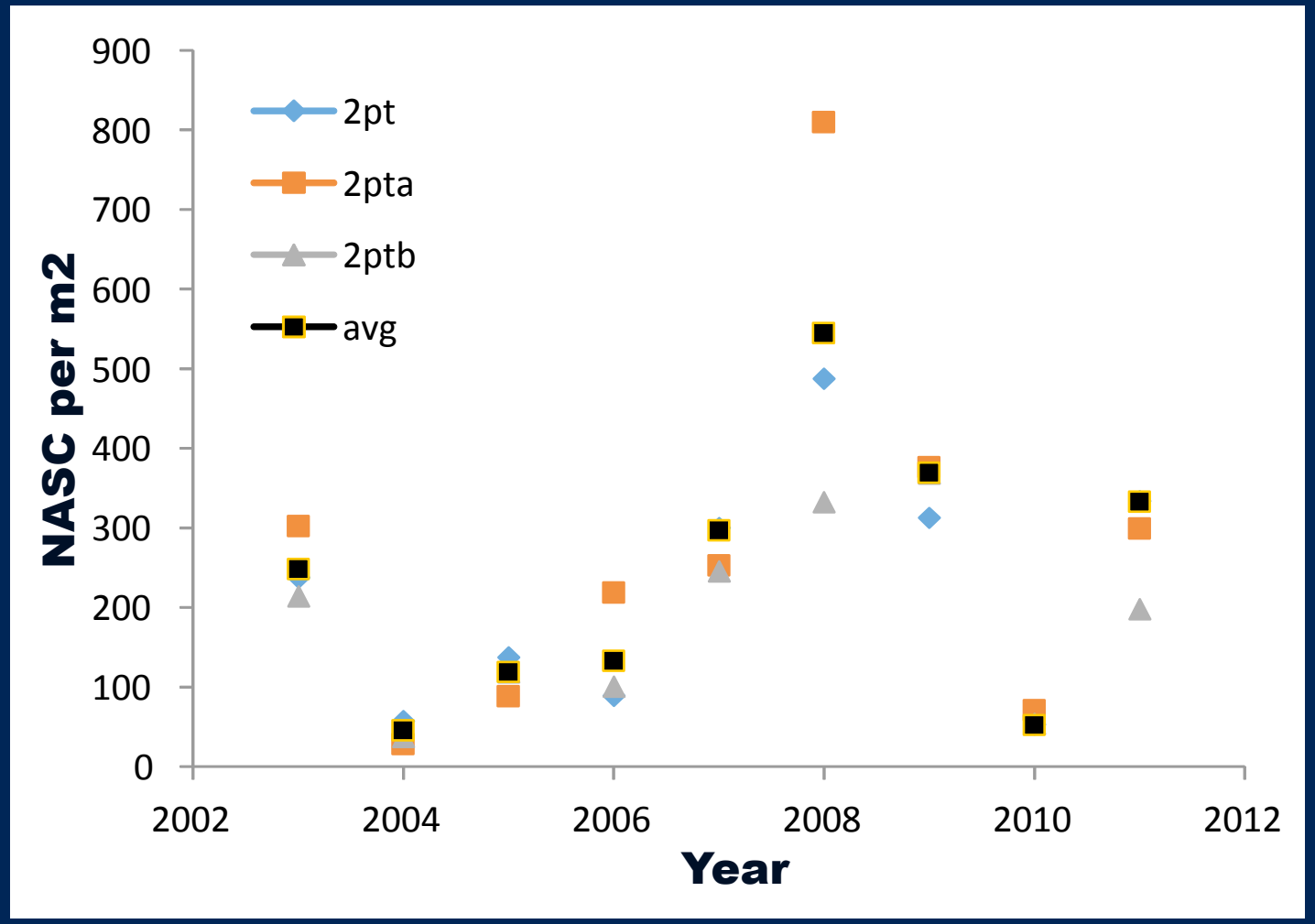
US AMLR data -- Resampling of repeat transects shows fishing vessel repeat transects can work in Peninsula area



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Pragmatic approach to increase local in season catch limit

$$\text{Catch limit multiplier} = \frac{\text{Late season KBI}}{\text{Early season KBI}}$$

Increased catch limit = Catch multiplier X Base catch limit

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Data necessary for assessing conditions to adjust local catch limits upwards

- Fishery monitoring of krill trends during season
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CEMP provides data from a number of sites to determine the status of predators throughout Peninsula

COMMISSION FOR THE CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES

CCAMLR ECOSYSTEM MONITORING PROGRAM

STANDARD METHODS

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June 2014 (revised)

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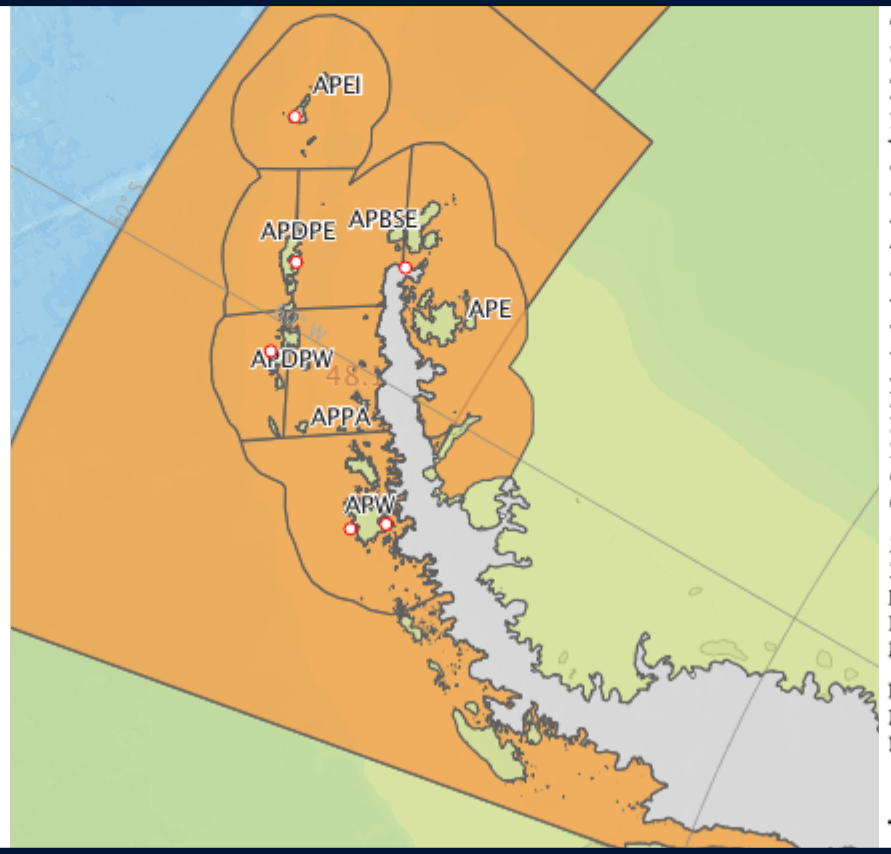

Table I. Parameters identified by the CCAMLR Ecosystem Monitoring Programme. * indicates parameters for which a monitoring protocol is under development.

Label	Parameter
A1	Penguin adult weight on arrival at breeding colony
A2	Penguin incubation shift duration
A3	Penguin breeding population size
A4	*Penguin age specific annual survival and recruitment
A5	Penguin duration of foraging trips
A6	Penguin breeding success
A7	Penguin chick weight at fledging
A8	Penguin chick diet
A9	Penguin breeding chronology
B1	Black browed albatross breeding population size
B2	Black browed albatross breeding success
B3	Black browed albatross age specific annual survival and recruitment
C1	Fur seal cow duration of foraging/attendance cycles
C2	Fur seal pup growth
F1	Sea-ice cover - local
F2	Sea-ice cover within the ISR
F3	*Local weather
F4	Snow cover in the colony
F5	Sea surface temperature
H1	Local krill catch per unit effort
H2	Local krill catch
H3	Potential overlap between fishing areas and predator foraging areas
	*Local krill density
	*Krill distribution

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We can use U.S. AMLR data to test approaches to FBM

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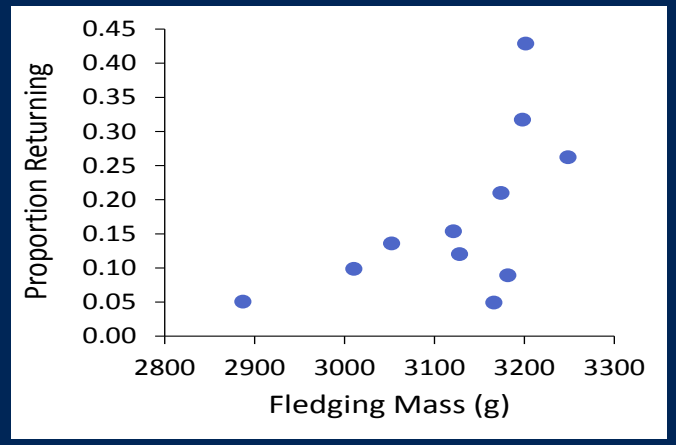
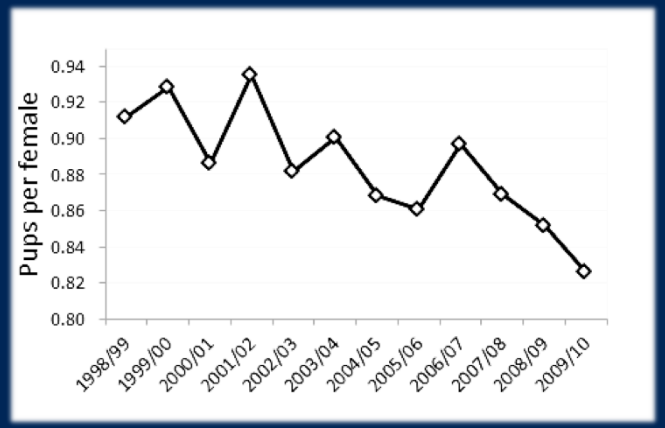
Expert classification of the relative conditions at Cape Shirreff (proxy for CEMP) using penguins

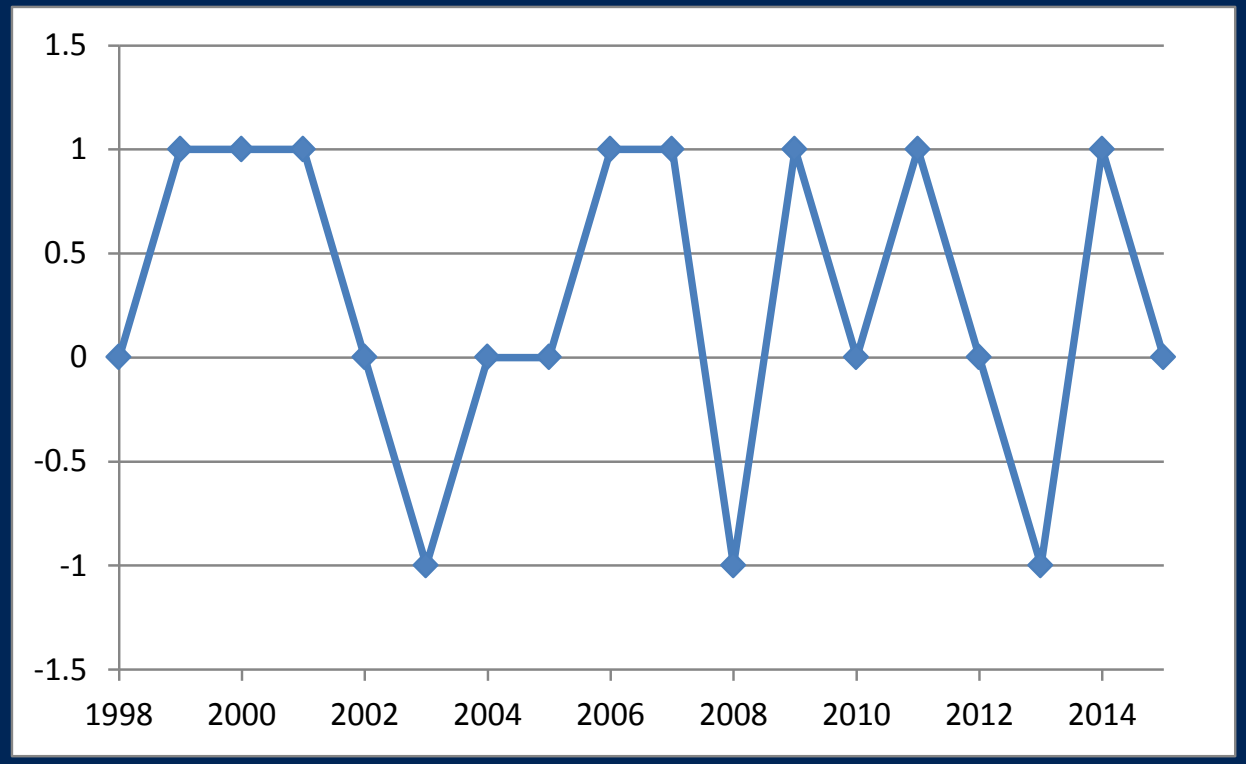




Good

Neutral

Poor



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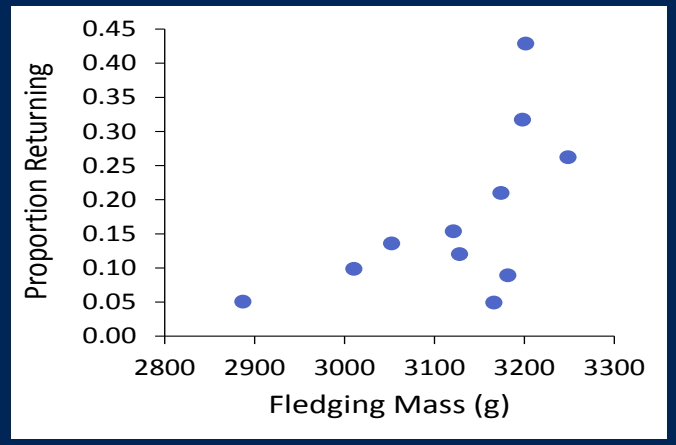
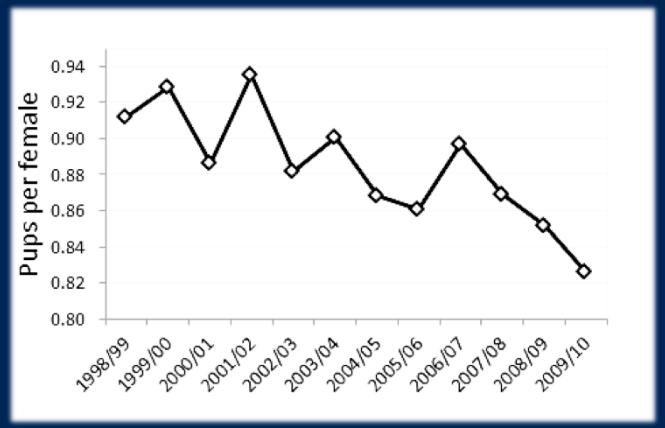
Expert classification of the relative conditions at Cape Shirreff (proxy for CEMP) using mammals





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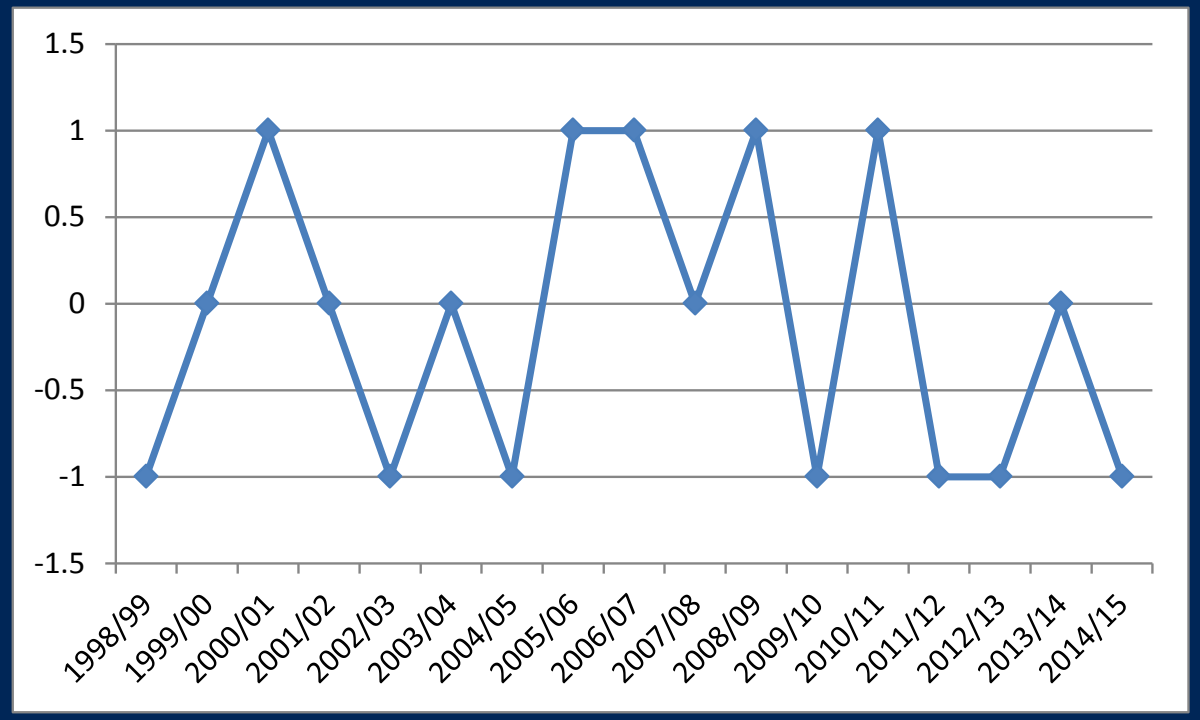

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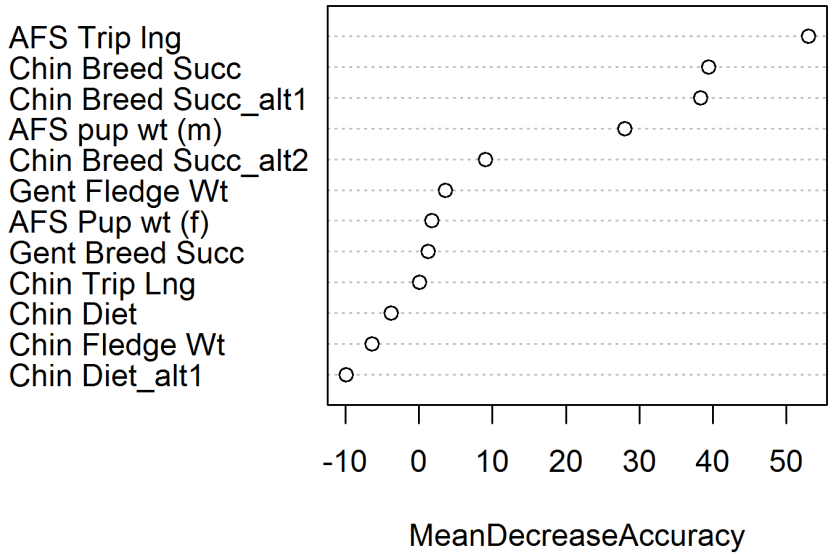
Predicted conditions at Cape Shirreff using expert classification of mammals and penguins for training



	Good	Neutral	Bad	Misclassification
Good	3	1	0	0.25
Neutral	1	2	1	0.5 (0.25)
Bad	0	0	6	0

- Correct classification rate of 78.6%
- Importantly, classification of "red light" was 100%
- Misclassification is balanced between good and neutral
- From 1998 – 2014 there were 6 "green light" (adjust up) years, 5 neutral years, and 7 "red light" years

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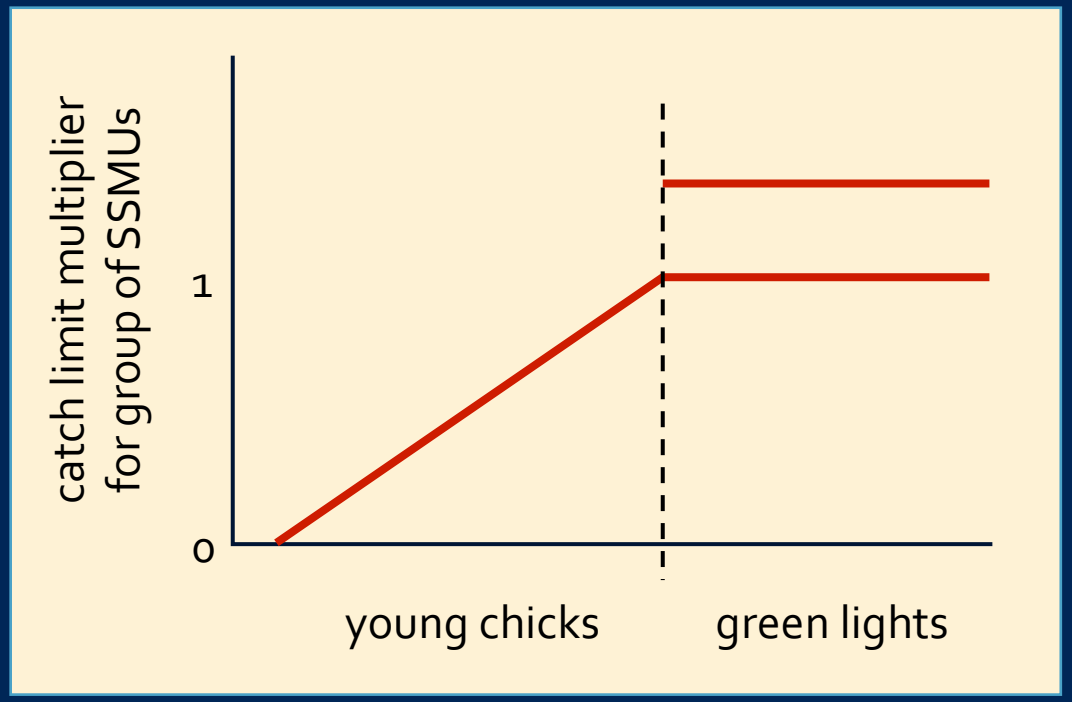
Stoplight approach



1) Intra-seasonal variability in the acoustic krill index over summer
   - Summer krill biomass is stable or increasing; winter could be good

2) CEMP indices are trailing indicators of conditions in the fishing area
   - Summer conditions have been good

3) Increase catch

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Answers to TOR questions

5. Are we appropriately analyzing and modeling ecosystem-level processes?

5. Integrating CEMP/ Fisheries/ surveys with appreciation of environmental change is fundamental to CCAMLRs approach to management

6. Is oceanographic, habitat, climate and ecological advice sufficiently included into living marine resource management advice?

6. Use of data from diverse sources (habitat/ biological/ oceanographic) to advise on status of ecosystem and for proposed catch limit adjustments

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STRENGTHS

- Time series of observations allows context for model development
- Incorporation of multiple datasets likely to provide robust estimates of state

CHALLENGES

- Maintenance and expansion of management schema unlikely without fishing vessels
- Responses to changes in the environment are not likely to be linear indefinitely

STRATEGIES

- Encourage multiple fishing nations to contribute
- Work with other nations to leverage CEMP indices (develop remote measures)

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